3.7 EXPLORING OTHER STARS

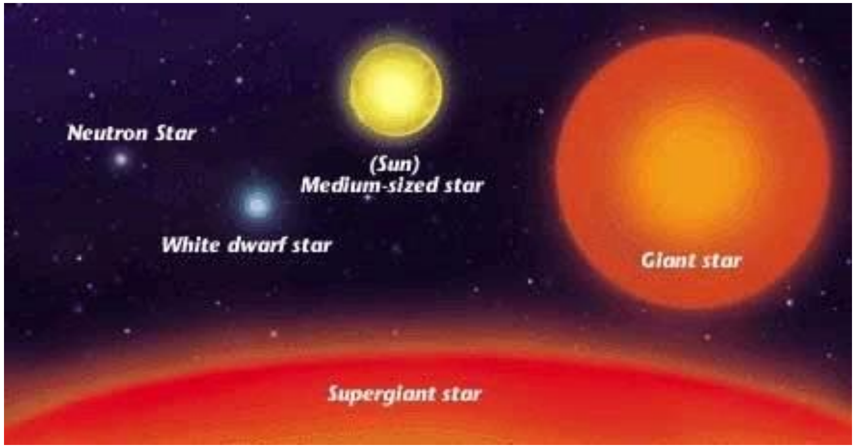
Brightness of stars

Luminosity is the star's total energy output, the Sun is faint compared to most stars, similar to…

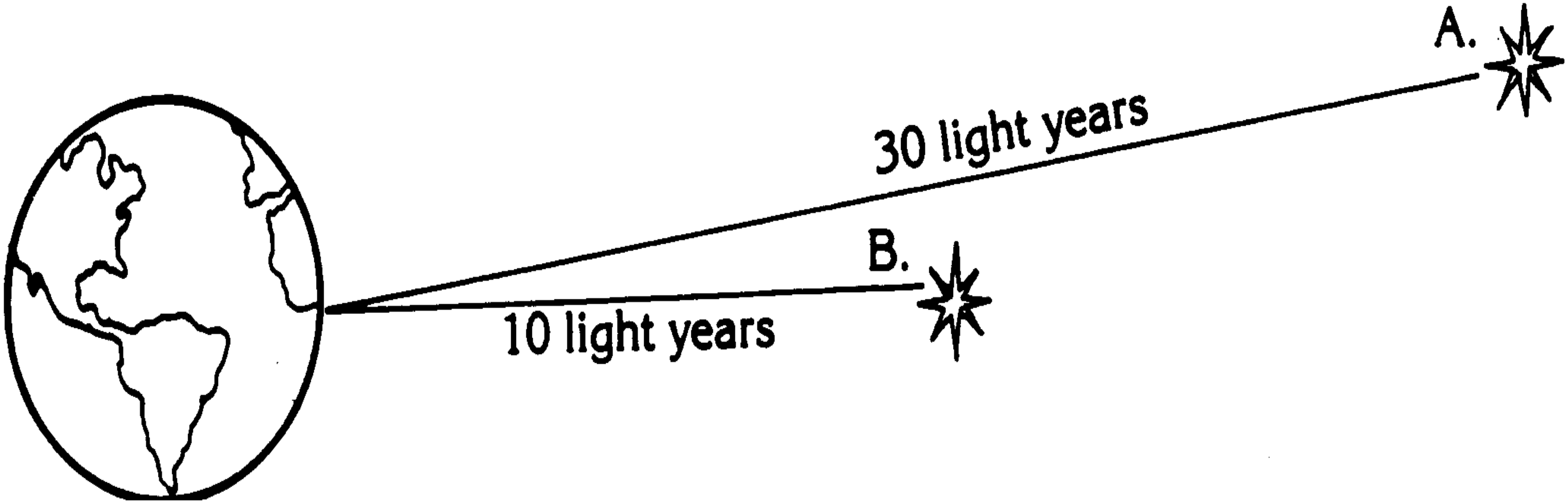
Absolute Magnitude is the actual amount of light energy a star will produce if we assume all stars are the same distance from Earth (32.6 light-years from Earth).

(Remember: the **apparent magnitude** (m) of a celestial body is a measure of its brightness as seen by an observer on Earth – smaller the number the brighter)

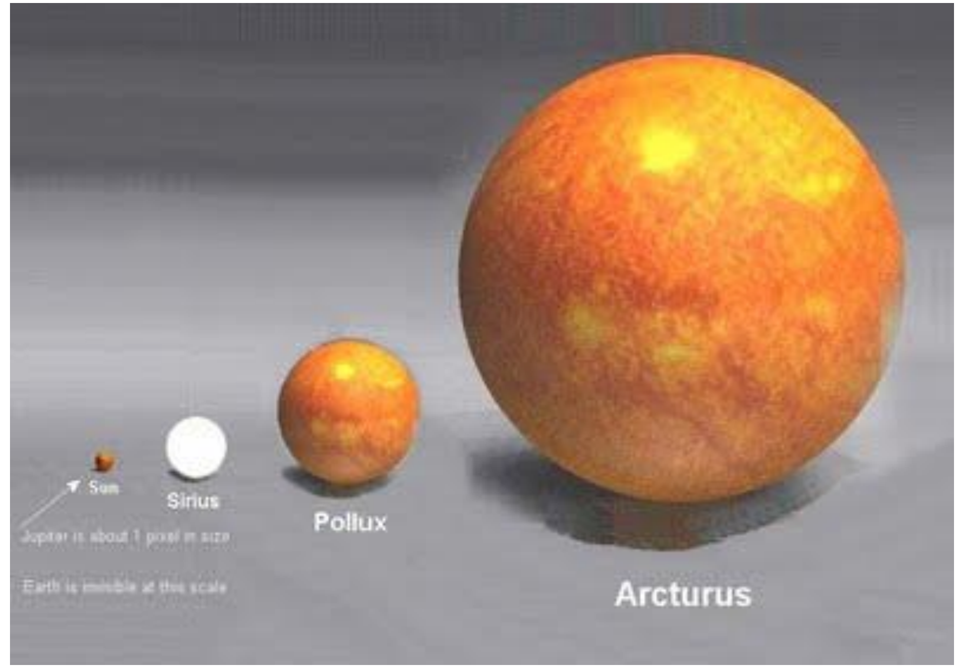
The apparent magnitude of the Sun is -26.8
The absolute magnitude of the Sun is ~4.7



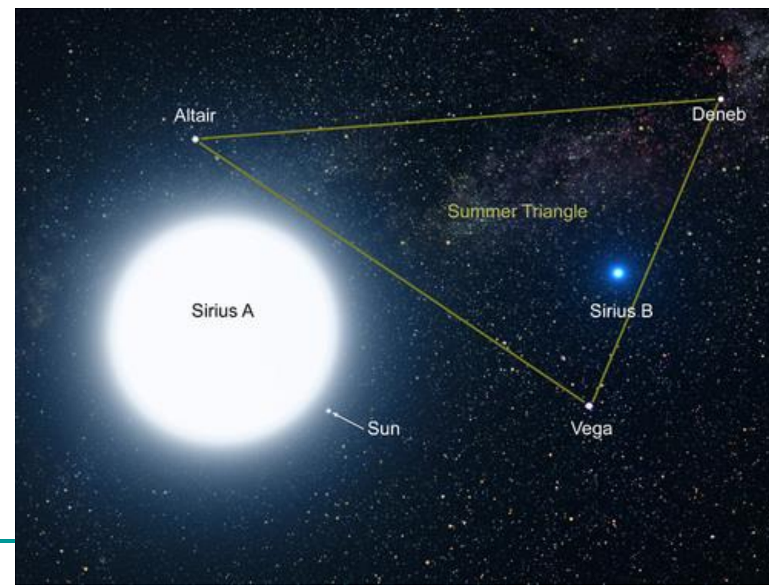
If both stars are the same size and temperature, which star is actually brighter? Why?



The Sun vs Sirius

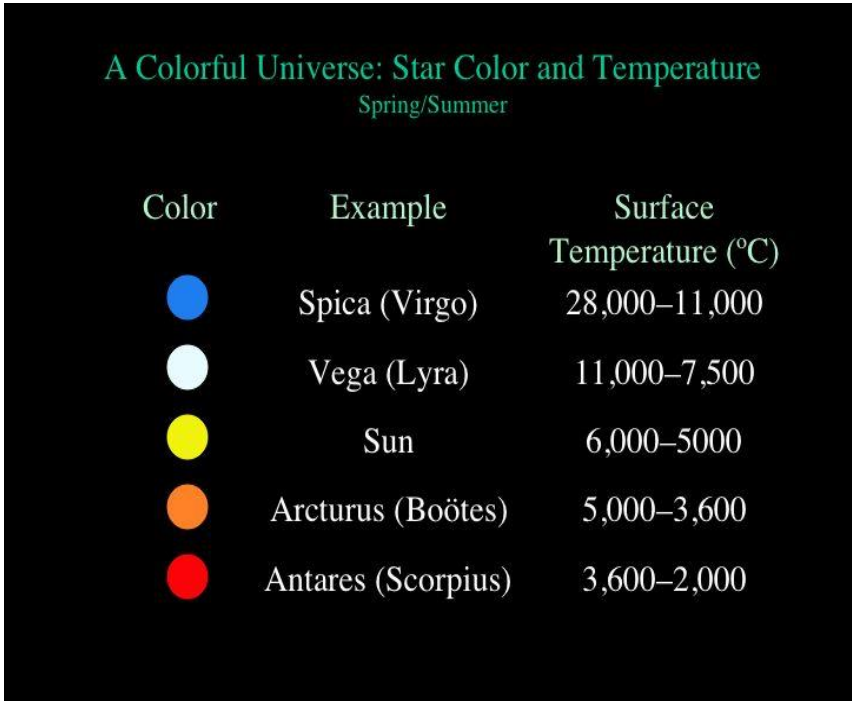


- Sirius, the brightest star in the night sky, has a luminosity 22 x greater than the sun



- The Sun appears brighter because it is much closer.

Star Colour and Temperature



A Colorful Universe: Star Color and Temperature
Spring/Summer

Color	Example	Surface Temperature (ºC)
	Spica (Virgo)	28,000–11,000
	Vega (Lyra)	11,000–7,500
	Sun	6,000–5000
	Arcturus (Boötes)	5,000–3,600
	Antares (Scorpius)	3,600–2,000

- Star colour – provides evidence of a star's temperature.

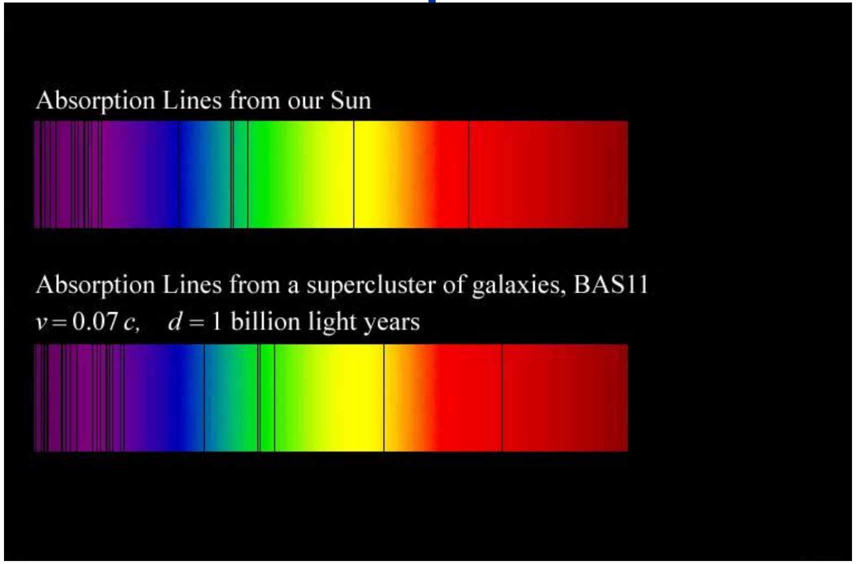
Star Colours:

- Blue – hottest stars
- White
- Yellow – Our sun
- Orange
- Red – lower surface temperatures.

hotter

cooler

Star Composition

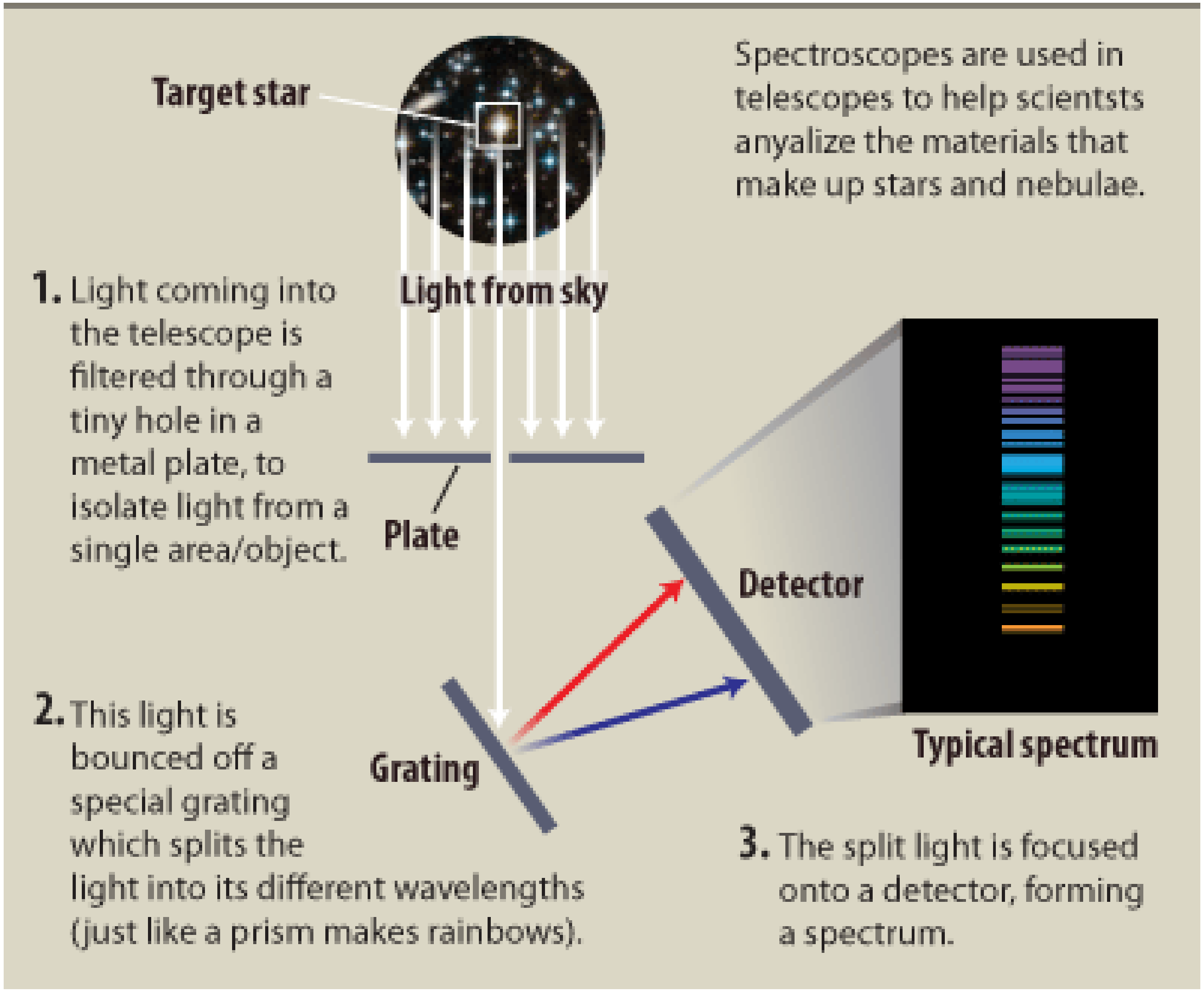


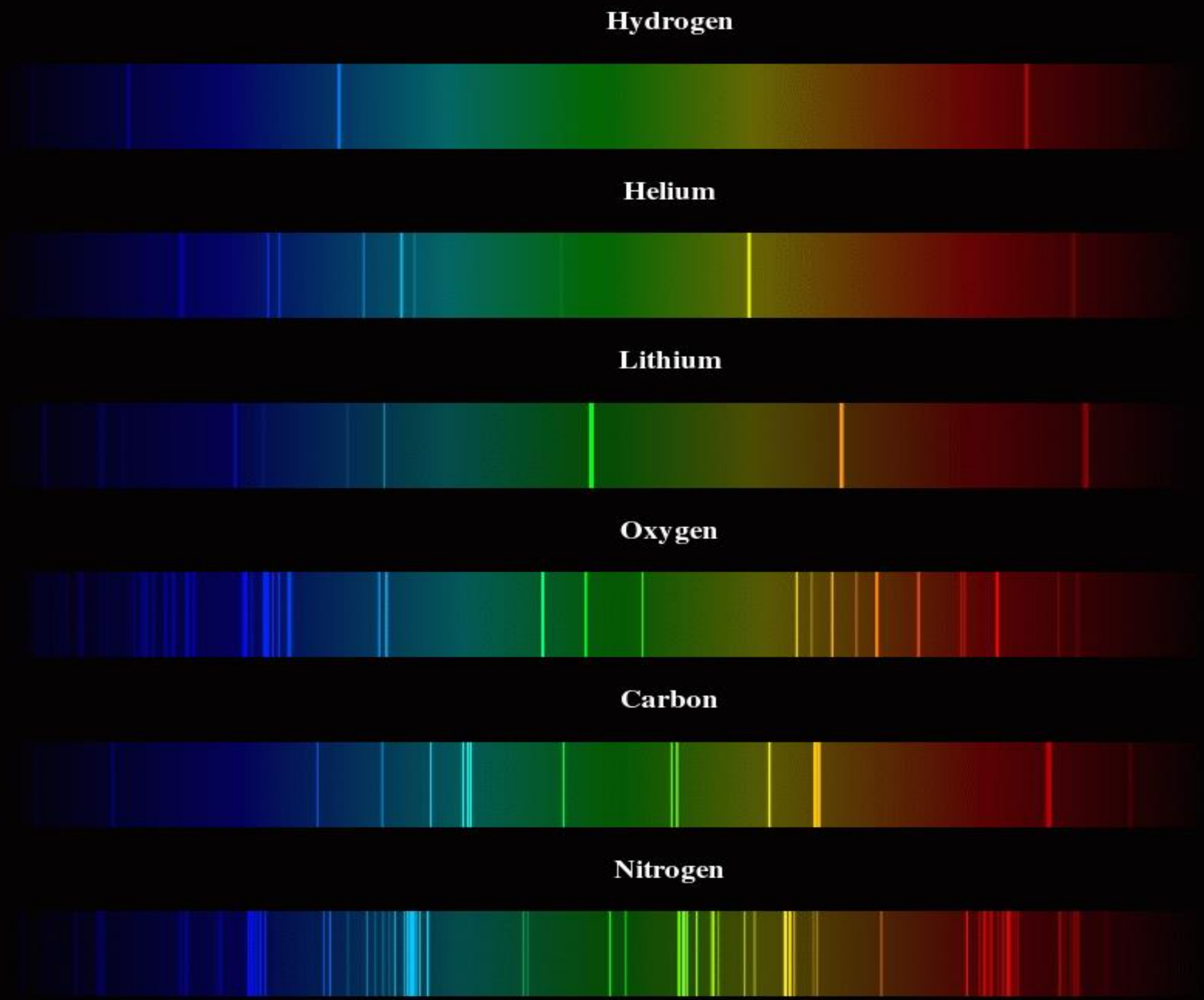
- Scientists use a **spectroscope** to observe the star's spectrum.
- The spectroscope creates a pattern of colours and lines.

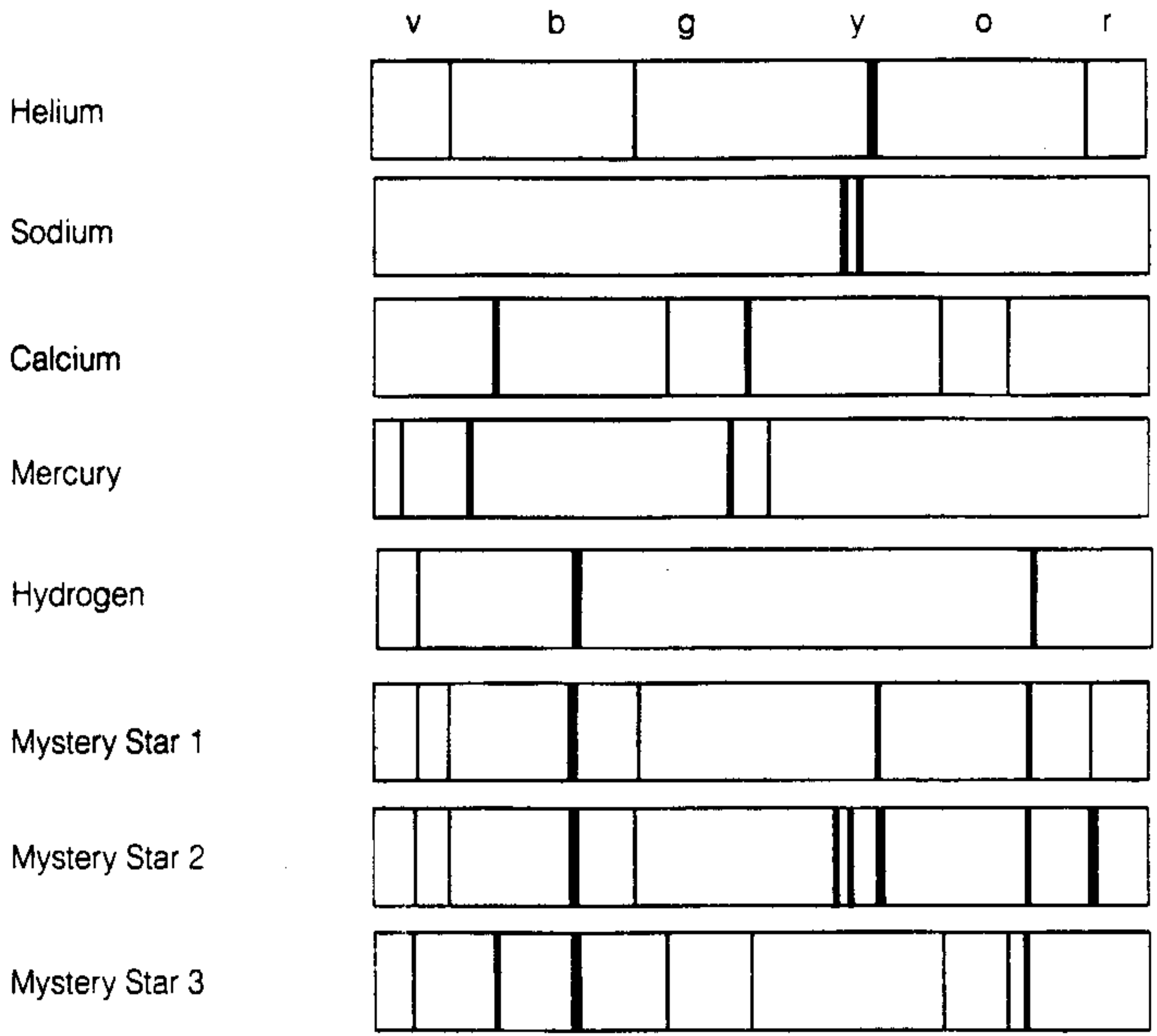
The pattern of lines can reveal the object's chemical makeup. This tell us:

Chemical composition
Percentage of each element
Temperature
Direction star is moving
video

How a Spectroscope Works



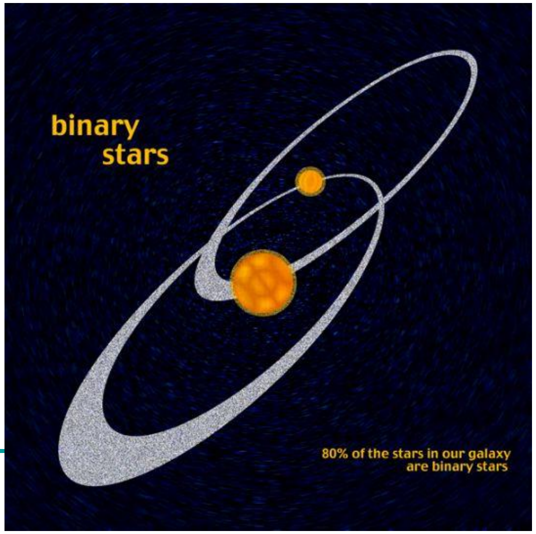

Hydrogen
Helium
Lithium
Oxygen
Carbon
Nitrogen



v
b
g
y
o
r
Helium
Sodium
Calcium
Mercury
Hydrogen
Mystery Star 1
Mystery Star 2
Mystery Star 3

The mass of Stars

- Determining the mass of stars was not possible until astronomers discovered that most of the star seen from Earth are binary stars.
- Two stars that orbit each other.
- By knowing the size of the orbit of a binary pair and the time the two stars take to complete one orbit, astronomers were then able to calculate the mass of each star.
- Star are expressed in solar mass.
- The Sun is 1 solar mass
- Other stars range from 0.88 to 100 solar masses.



Orbit animation

The Life Cycle of A Star

Stage 1
- Begins as a nebula

Stage 2
- Protostar emerges

Stage 3
- Main sequence stars (see H-R diagram)
- Bigger stars burn brighter for less time

Stage 4
- Old age
- Swell to be red giants, or supergiants (depending on their original mass)

Stage 5
- Death

Main sequence stars fuse hydrogen atoms to form helium atoms in their cores.

The Hertzsprung-Russell Diagram

Classifies stars by colour and absolute magnitude (or intensity)

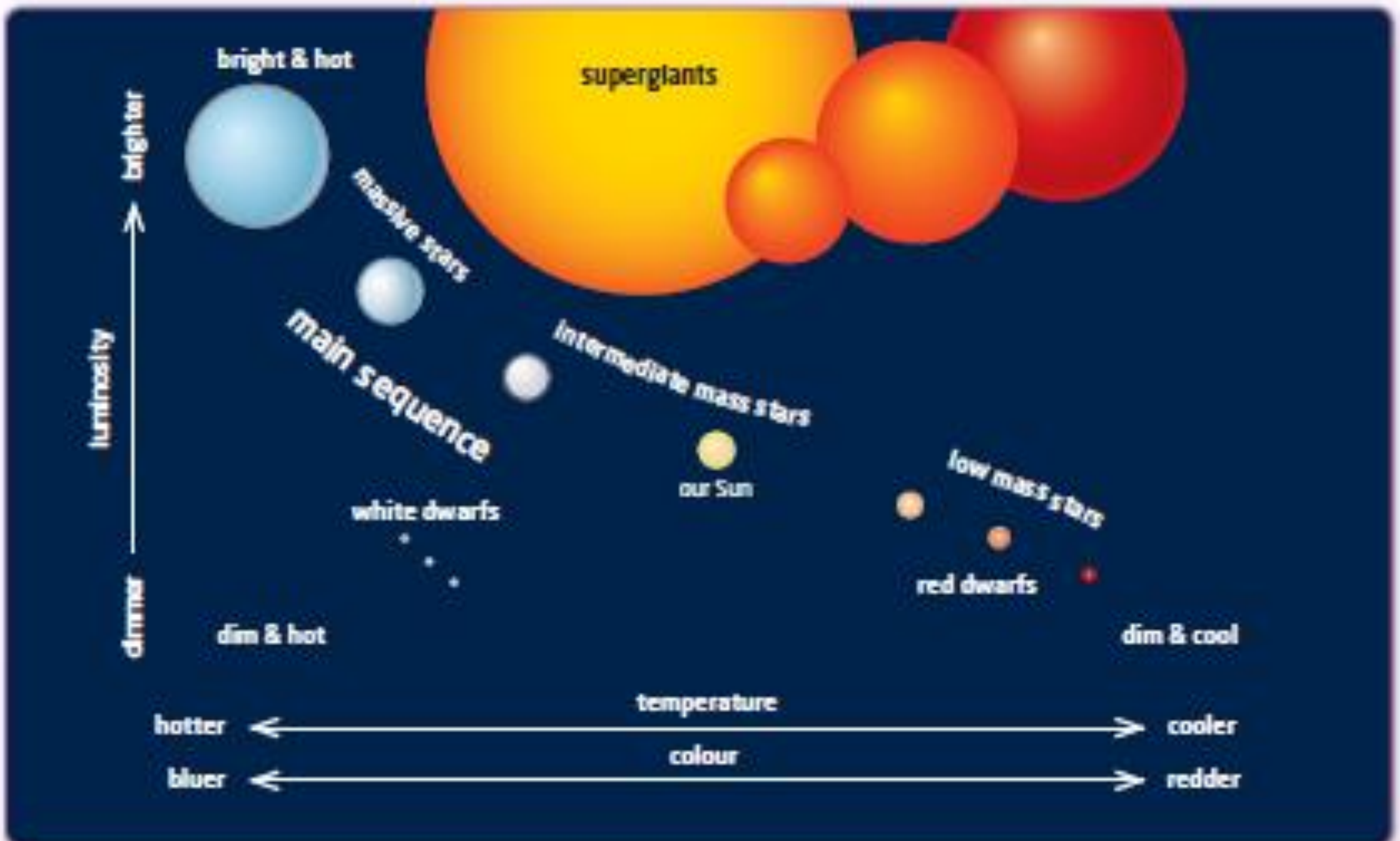
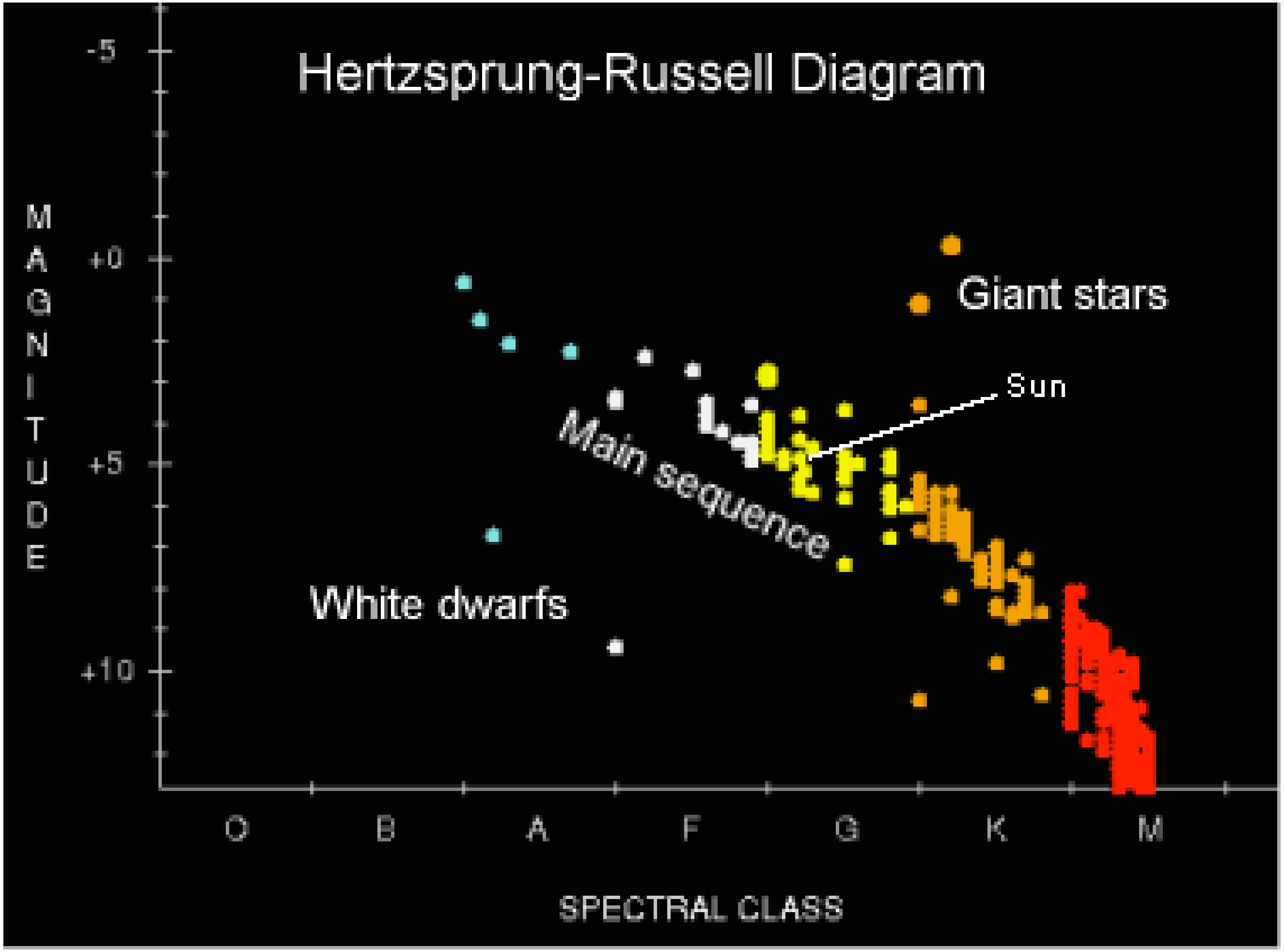


Figure 8.26 Hertzsprung-Russell diagrams like this one show trends in the evolution of stars. For example, most cool stars are much dimmer than hot stars, and most hot stars tend to be more massive than cool stars.

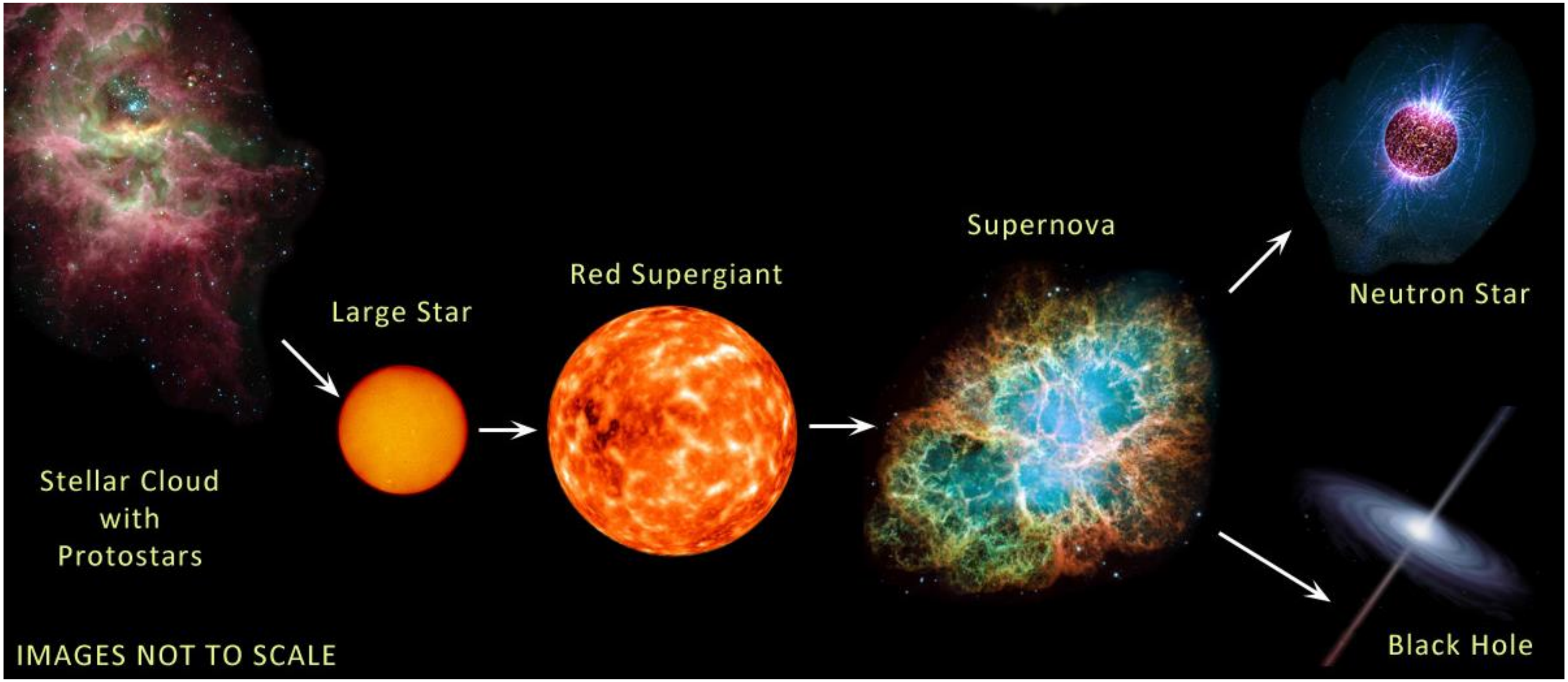


What is a star with spectral type A and an absolute magnitude of +7?

The Life Cycle of a Star (anim)

- Below are flowcharts for the life cycle of each of the following stars:
  - **Low-mass star** → a red dwarf → live 100 billion years → slowly lose mass → becomes a white dwarf → cools down → black dwarf (has not been observed – why?)
  - **Intermediate-mass star** → Sun → live 10 billion years → lose mass faster then a low-mass star → hydrogen used up core collapse and outer layer expands → red giant → white dwarf
  - **High-mass star** → consume fuel fast → die more quickly → less then 7 billion years → uses up hydrogen fuel then collapses then expand into a supergiant → helium used up iron fuses → collapses again supernova → remain core is either a neutron star or black hole depending on the stars original mass.

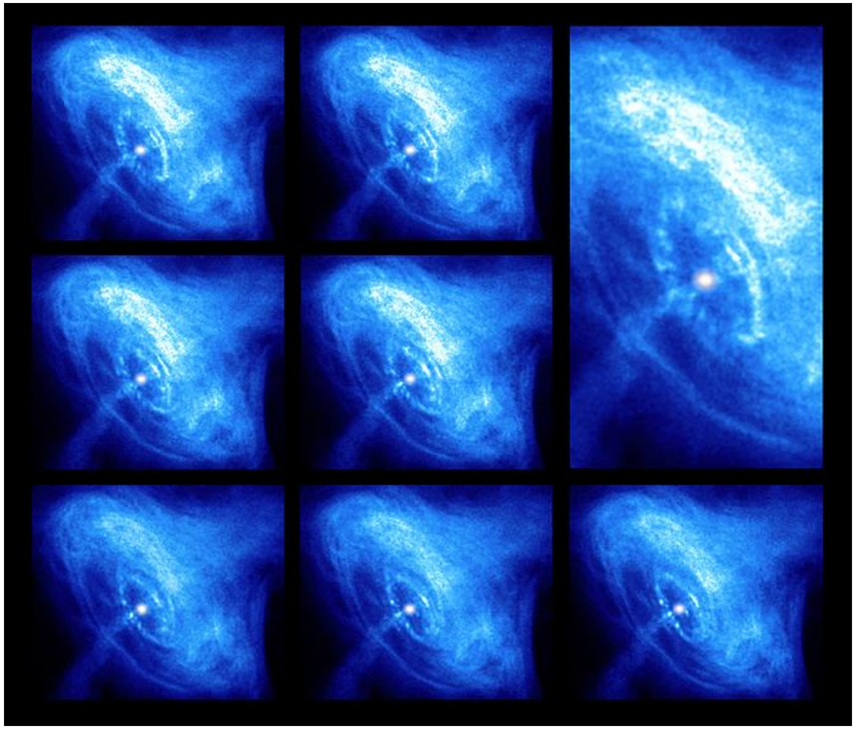
Large Stars: produce a supernova then form either a neutron star or a black hole



Neutron Star

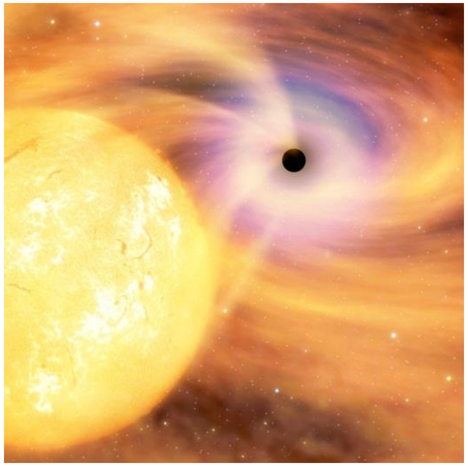
- In very high mass stars after the supernova, gravity crushes the core into a super dense sphere.
- A spoonful of a neutron star would weigh as much as Mount Everest.
- Some neutrons stars spin very quickly and emit high-frequency radiowaves, which are detected as pulses, these neutron stars are called **pulsars.**

Image of a pulsar at the centre of the Crab Nebula



Black Holes

- In the heaviest stars, after supernova the core collapses until it becomes a “black hole”
- The gravity is so strong that within a certain distance nothing, not even light, can escape it.
- Before matter spirals into the black hole, it heats up and emits radiation – this is what we can detect.



http://hubblesite.org/explore_astronomy/black_holes/

(black hole interactive site)

Assigned work:

Rd. p.294 to 301

Q p.305 #2, 3, 5, 6, 11, and 12